

# URBAN AIR MOBILITY: INITIAL REFLECTIONS

## APPROACH TO AIRSPACE INTEGRATION

*ENABLING SCALABLE, EFFICIENT, AND SAFE ACCESS TO AIRSPACE*

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# URBAN AIR MOBILITY AIRSPACE INTEGRATION PRINCIPLES

- Secure operations
- No burden on current system
- Interoperability with others
- Performance-based
- Efficient
- Safe
- Scalability and sustainability



BUILD ON THE FOUNDATION OF  
UNMANNED AIRCRAFT SYSTEM TRAFFIC MANAGEMENT (UTM)

# PRINCIPLES AND ENVISIONED CONCEPT

## Secure

- Only authenticated operators are allowed

## Cooperative

- Share intent with others- cloud-based architecture
- Constrained free trajectory generation
- Coordinate with others for spacing and separation

## Interoperability

- UTM defined data exchanges and services
- Performance will indicate where to operate safely

## Efficient

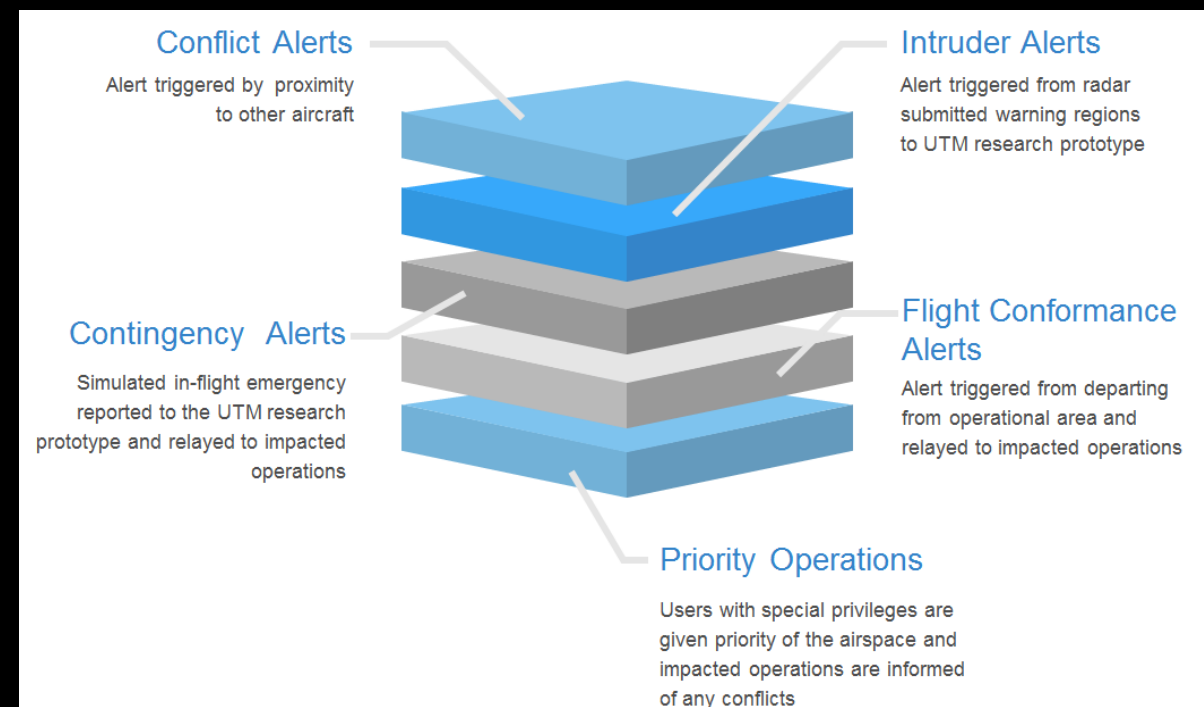
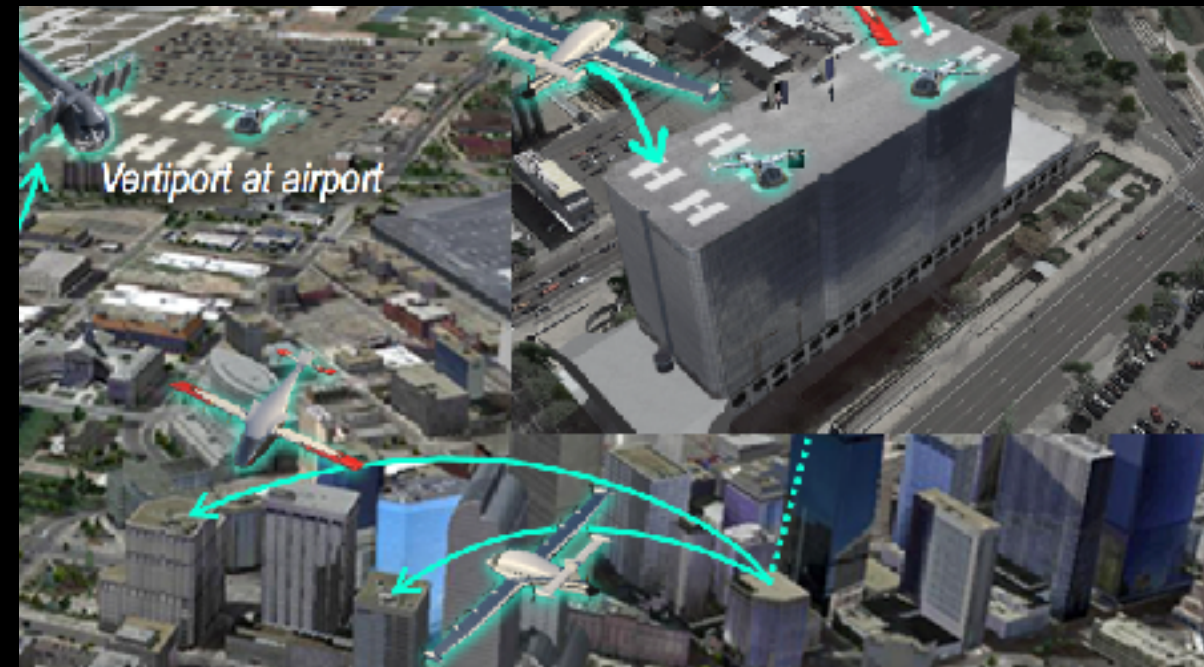
- Dynamic updates to maximize efficiency

## Safe

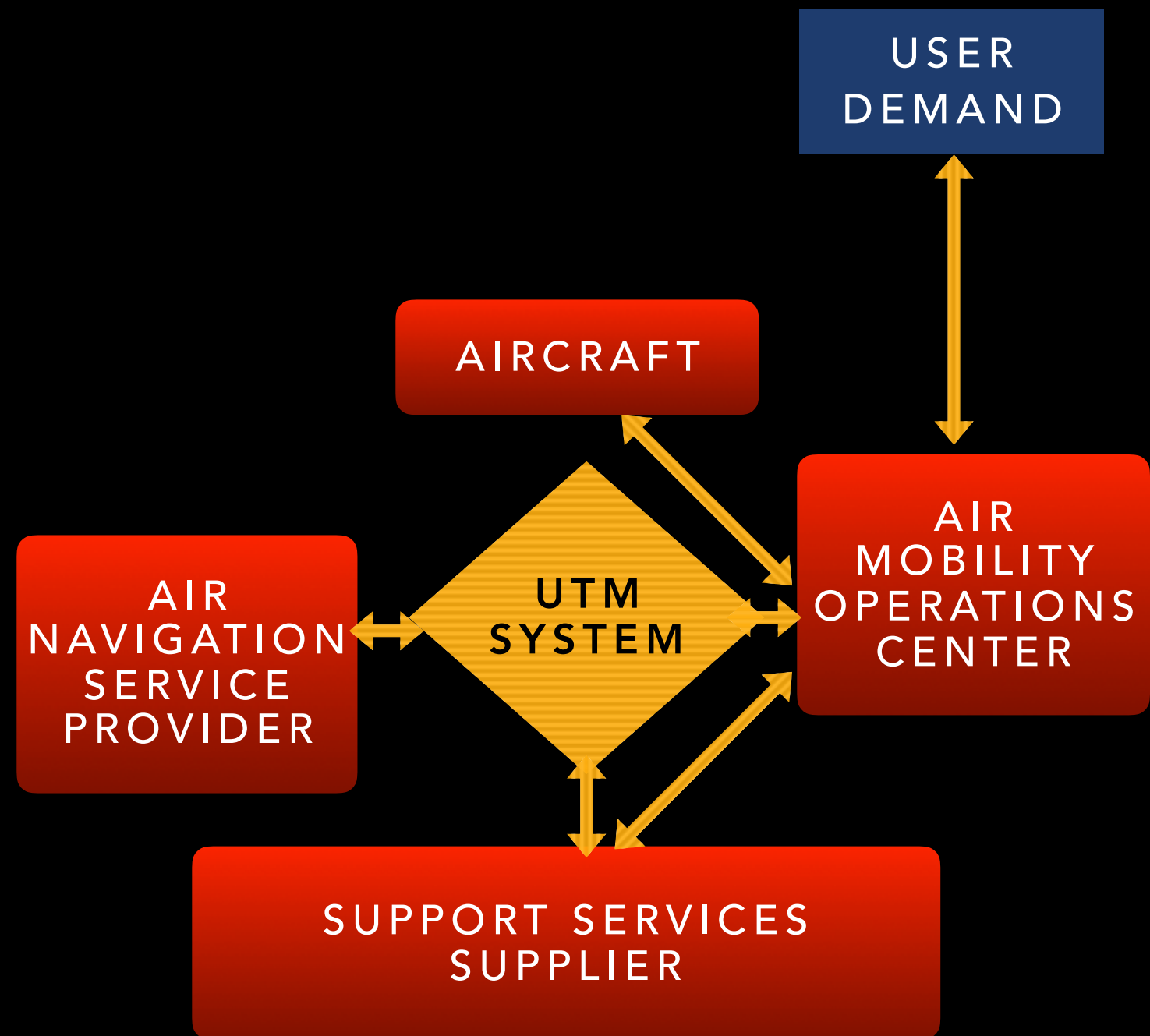
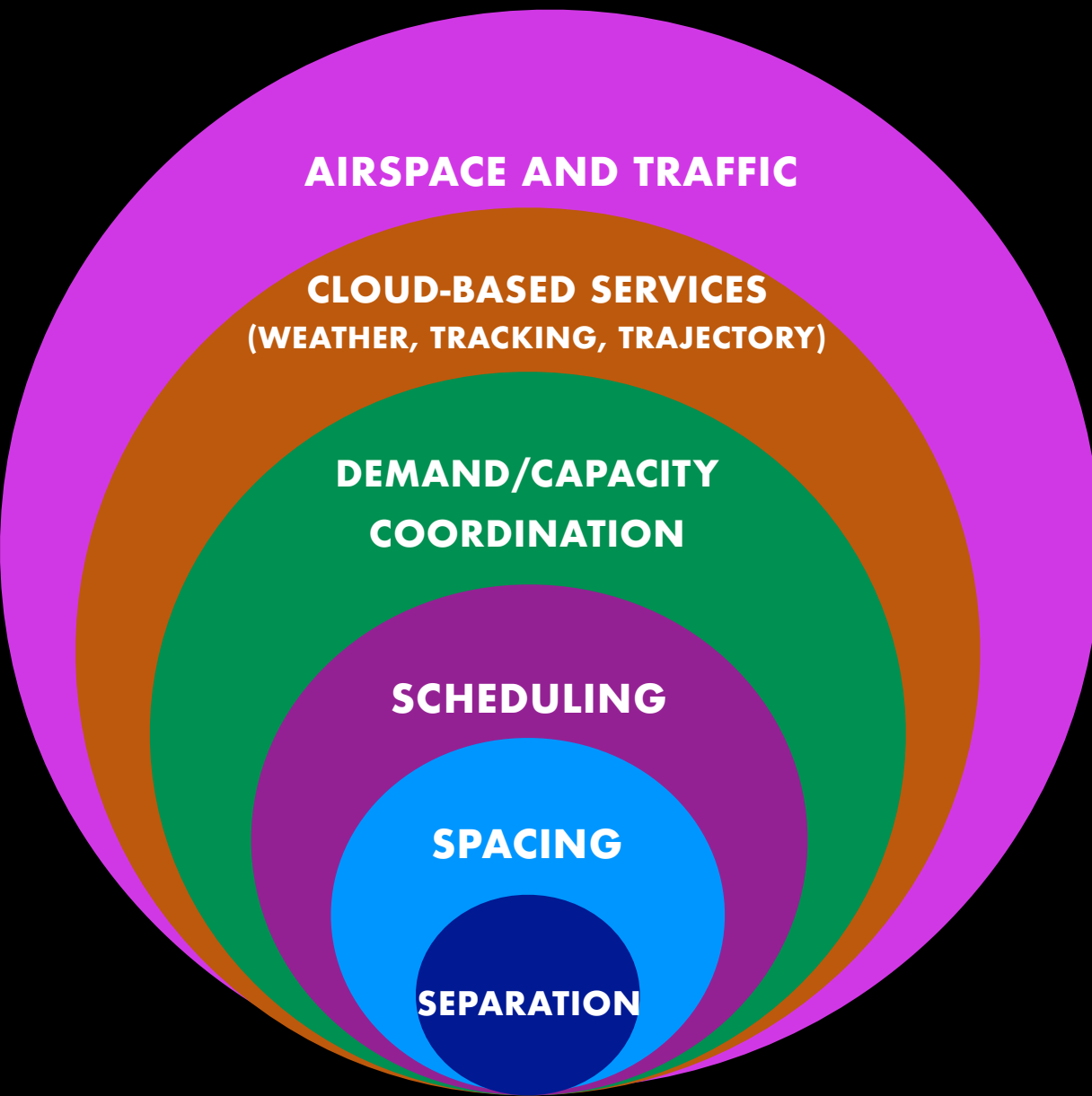
- Ready for contingencies and off-nominal operations (e.g., landing spots, weather)

## Scalability and Sustainability

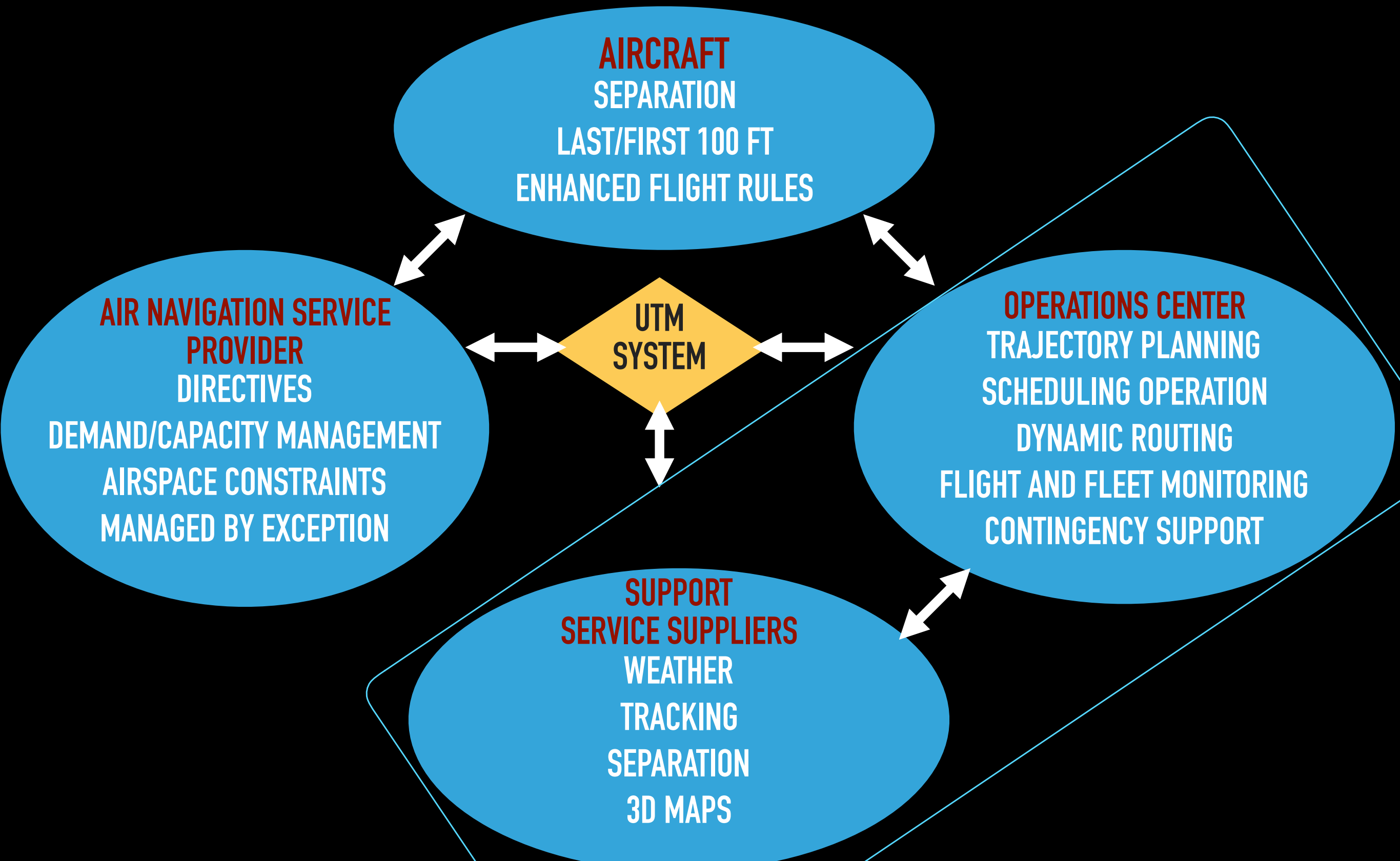
- Self-management without overloading ATC
- Many operator or third-party services
  - Track and locate, communications, weather, separation coordination
- No additional investments from Air Navigation Service Provider



# CONNECTED SYSTEM FOR SCALABILITY

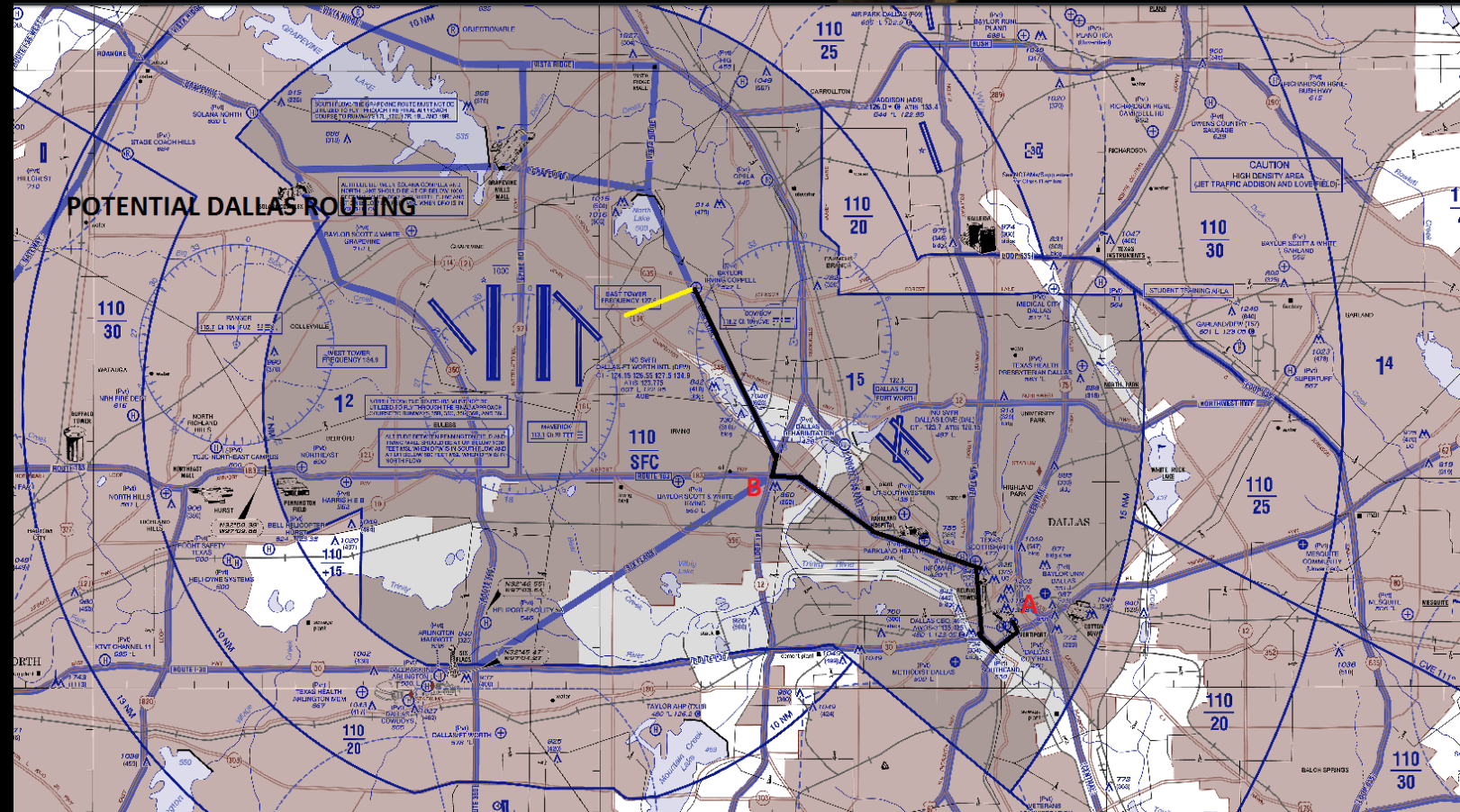






# NEAR-TERM OPERATIONS

- Low density operations
- Helicopter routes
- Class B cut outs
- Use preliminary UTM capabilities such as Low-altitude authorization and notification capability as much as possible
- ATC clearances, as needed

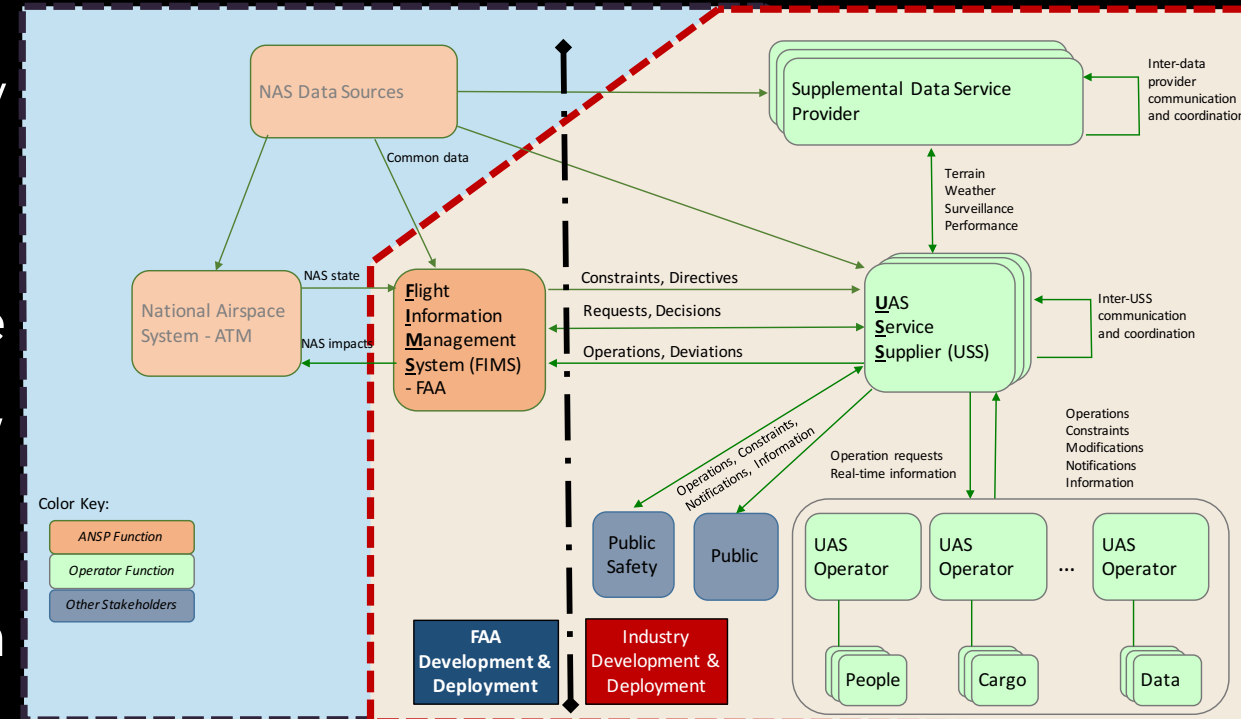


RESEARCH NEEDED TO IDENTIFY LIMITS AND APPROACHES NEAR-TERM



# PATH FOR SCALABILITY

- Architecture, roles/responsibilities and technology that allows self-management as much as possible
- Air traffic control interacts indirectly for the majority of flight - for constraints and directives, and airspace changes
- Operator plans and schedules operation through UTM
- Tracking via wireless, satellite, ADS-B, or beacon-based systems connected through UTM
- Air-ground-cloud integrated system for scalability (spacing, separation, etc)
- Last/first 100 feet for safe take-off and landing
- Vertiport design and operations for multiple simultaneous arrivals and departures



**AIR, GROUND, CLOUD INTEGRATED OPERATIONS AND SYSTEM**



# CRAWL-WALK-RUN APPROACH

## Low-density: Initial Operational Capability

- Helicopter routes using today's procedures
- Clearance into controlled airspace (UTM - authorization and notification)
- User created conflict-free trajectories and own tracking



## Medium-density: Interim Operational Capability

- User creates conflict-free trajectories
- Interoperable, cooperative, intent sharing through UTM
- Self-managed operations (e.g., detect and avoid, contingency management)



## High-density: Mature Operational Capability

- Fully-autonomous planning, scheduling, separations, entry/exit controlled airspace, interoperability, and contingency management
- Multiple, simultaneous take-offs and landings





BACK UP

# CRAWL-WALK-RUN APPROACH

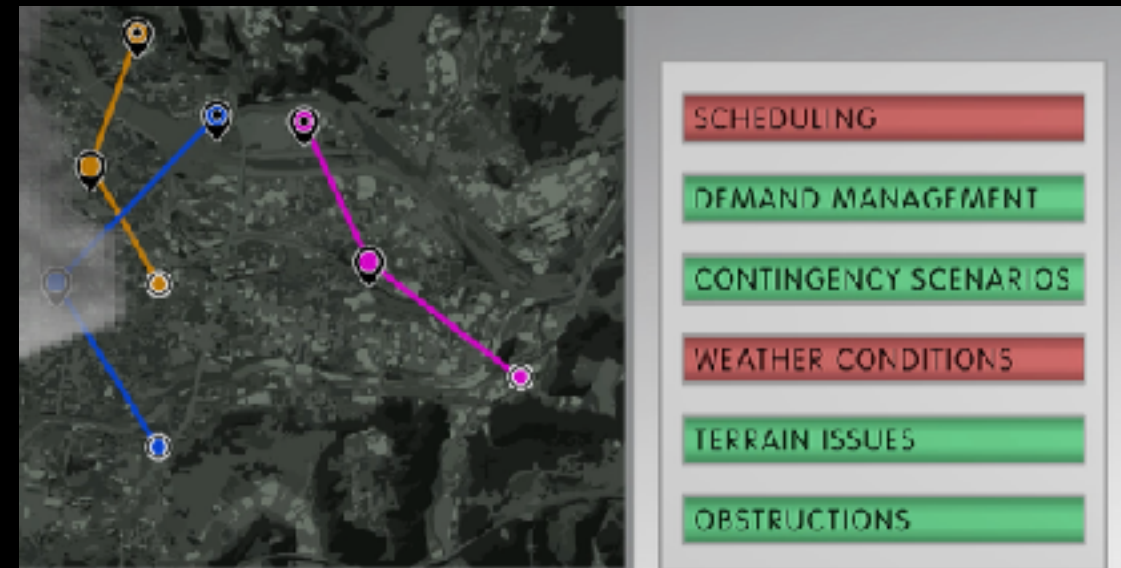
## Low-density: Initial Operational Capability

- Helicopter routes, today's procedures, clearance into controlled airspace, user created conflict free trajectories and own tracking (UTM/LAANC - authorization and notification in controlled airspace)



## Medium-density: Interim Operational Capability

- UTM-style interoperable, cooperative, intent sharing, self-managed operations (e.g., detect and avoid, contingency management)



## High-density: Mature Operational Capability

- Fully-autonomous planning, scheduling, separations, entry/exit controlled airspace and UTM-style interoperability
- Multiple, simultaneous independent take-offs and landings

